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ABSTRACT

Producing goods and services of high quality is not expensive, but correcting poor quality costs U.S. companies as much as 20 percent of sales revenues annually. One survey reported that only 1 out of 300 U.S. companies involved management and engineering staff in quality training. The tendency is to have a quality control department, separate from other functions. National policies must help improve the quality of the U.S. work force and of working life; enhance the quality of products, services, and technologies; generate new technologies; provide technical assistance to industry and commerce; and establish the leadership to move into the next century of international competition. It is recommended that quality programs be established in federal departments that influence the nation's quality (such as the Department of Labor, the Internal Revenue Service, and the Department of Defense); a Presidential Commission on Quality and Competitiveness disseminate information; individuals and companies that are leaders in the pursuit of quality be rewarded; vocational training at the postsecondary level be increased; participative management be increased; and networks of industry, union, academic, and government representatives be established to give managers and employees of companies information on quality and production techniques. (79 references) (CML)

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36. EFFORTS TO SOLVE QUALITY PROBLEMS

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36. EFFORTS TO SOLVE QUALITY PROBLEMS

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INTRODUCTION

There is a crisis in America that goes to the very heart of our way of life and our quality of life. That crisis deals with the quality of goods and services produced in America. It is reflected in the education our children receive, our health care system, government services, the quality of our jobs, and the stress of our lifestyles. We are being hard pressed by other countries which want a part of the American dream, and which are capturing American markets at home and abroad, along with American jobs. Some of our own industries are moving overseas because they believe cheap labor will provide more economical production and improve their competitive advantage.

Many believe that we are headed for an economic crisis caused by the reduced ability of our manufactured goods to compete with foreign goods. Likewise, there is foreign encroachment into service industries such as finance, temporary help and retail trade. American products are losing customers and this loses jobs for Americans. Worries have centered not only on the lower price of foreign products (which may be primarily due to much lower labor costs, government supports, and low

overhead), but also on the superior quality of foreign products. Increased pressures from international competition for sales in the United States, and an inability of American products to compete well in foreign markets has resulted in our balance of trade deficit growing to record levels. While new technology can give us a competitive boost our edge in technology narrows each year. Soon we may not have any edge at all, because of the ease of copying new discoveries. The best way to beat foreign competition is through high quality, innovative products and services at competitive prices.

A NEW APPROACH TO QUALITY

Lately there has been a lot of news about the quality revolution in Japan. In particular, high-quality low-cost electronic and automotive products have flooded the U.S. market. Some believe that Japan is dumping these high quality low priced products below manufacturing cost to create long term markets. Generally, this has not been true. It would not be possible to build the industrial complex that Japan has by losing money on each sale. This illustrates a widespread misperception that high quality necessarily requires spending more money. High-quality is not expensive. Quality management is a very rational, cost effective approach to conducting business that is necessary to become competitive in an increasingly competitive international market place. A popular definition of "Total Quality Management" is: an approach for continuously improving the quality of goods and services delivered through the participation of all levels and functions of the organization (Pfau, 1989). It has been estimated that

finding, repairing and/or replacing mistakes and product flaws represents about 25 percent or more of sales (Crosby, 1982; 1983). The Act establishing the Malcolm Baldridge National Quality Award states that poor quality costs companies as much as 20 percent of sales revenues nationally (Congressional Record, 1987). The Defense Department estimated in mid-1983 that defective procurement constituted between 10 to 30 percent of the weapons budget, or as much as $10-30 billion annually (Aviation Week and Space Technology, 1987). Thus, low quality is expensive.

Garvin (1983) conducted a study of production operations of manufacturers of air conditioners in both the United States and Japan. He found that even the poorest Japanese company had a failure rate less than half that of the best U.S. manufacturer. High quality was also related to high productivity as measured by output per person-hour. He concluded that high quality in Japanese companies was due to "sound" management practices, such as working with vendors to improve their performance, educating and training the workforce, setting targets for quality improvement, relying on specific and timely information on defects and field failures, and demonstrating top management interest and commitment. In addition, he emphasized long-term commitment to quality as a success factor in Japanese companies as opposed to quick fix solutions in American companies.

Another fallacy that has hindered the widespread utilization of quality management principles is the perception that quality is achieved by inspecting for defects after the product is completed. Even the best inspection system cannot guarantee that defects will not reach the

customer, and such inspection is very expensive. It is a misconception to think that quality is a minor technical issue, mostly concerned with administrating inspection procedures, and consequently can be delegated to a separate corporate department. The foremost principle of modern quality management is to ensure that defects are not made in the first place. This is achieved through carefully designed systems, by constantly seeking to improve existing processes, and by building quality "in" during each step of the production process.

The quality approach has repeatedly proven to be cost effective. At General Dynamics, the first-time yield in a machine shop at a division increased from 66 percent to 83 percent in acceptance rates (Boileau, 1984). At Westinghouse, the yield of fully-conforming printed circuit boards increased from 60 percent to about 90 percent (Ryan, 1983). The quality improvement project implemented at a bank yielded an increase of 17 percent in productivity (Eldridge, 1983). The quality efforts in a Dow plant yielded a 50 percent improvement in attendance, 28 percent reduction in manpower, increase in on-time shipment and improvement in customer relations (Bemowski, 1988). As a result of improvements suggested by an employee group at a Ford plant, the reject rate through the valve-centering machines has been reduced by about 37 percent (Tavernier, 1981).

Modern quality improvement philosophy is based on involvement and participation from top management to the shop floor, customer orientation, comprehensive quality monitoring, supportive management systems, and a continuous improvement philosophy. Delivery of quality is analogous to a chain where the weakest link determines the strength

of the whole chain. All processes (links) in the whole company need to be devoted to delivering quality products or services. Even if a minor process has a glitch, the final product or service can be defective; defects are expensive to rework and produce unhappy customers. This philosophy requires cooperation between management and labor.

It is often assumed that quality control or quality improvement is limited to manufacturing. The delays, costs and other problems that result from bad quality in administrative procedures and decisions, for example, burden both private industry and government agencies. Ultimately, quality costs are a burden to the whole U.S. economy. In particular, with respect to export industries, it is important that all processes, administrative and others, be of high quality and low cost. Quality in internal services can affect our exported products. For example, it has been claimed that some American-made automobiles have a $600 "overhead" charge just to cover the cost of employee health care services. Quality management principles apply equally well to services as to manufacturing.

CONCEPTS OF QUALITY

Quality has many characteristics which tend to make it a complex issue even though it seems so simple. Quality is an integrated aspect of all steps in a process that defines the qualitative character of the output of that step; additionally, quality is a personal perceptual label that defines the individual's judgement about a product or step. Thus, quality has a perception aspect and an action aspect. The following is a structure through which "quality" can be defined and

examined. Garvin (1984) has proposed five different ways to define the various facets of quality. The first way is the transcendent view which is the psychological concept of "quality" as an individual perception that varies from person to person. Each of us has our own definition of quality and we can subjectively rate products and experiences qualitatively. There are products that we "like" and those that we do not like. The second aspect can be quantitatively defined in terms of specifications or desired attributes of a product. Is it the right color? How many doors does it have? The third is "user" or "customer" based and is market driven. Quality consists of product characteristics that increase consumers' satisfaction and promote greater customer desire to acquire the product. Individual perception is not as important as global group perceptions. The fourth level of definition is primarily concerned with engineering design and manufacturing process considerations. Quality is a process of conformance to requirements and/or specifications. Deviations from these result in reduced quality. Last, there is the value-based level. Quality is reflected in the greatest product performance characteristics for an acceptable or equal price.

Quality is not an entity in itself, it is an attribute of other entities (products, services, processes, people, etc.) as perceived by different players in the market place. Quality professionals and general customers have a variety of views on what makes the quality in products and services (West, 1987). Takeuchi and Quelch (1983) emphasized that quality goes beyond making a good product. It also includes focusing on worker motivation, design, and the production

process. Quality is also a matter of watching for key trends in customers values and perceptions. Thus, the management of quality pervades all aspects of management and should be approached from a "total system" perspective. We envision quality at the workplace as having at least three separate, yet interrelated, aspects. These are the quality of the goods and services produced, the quality of the workforce, and the quality of working life. High quality goods and services cannot be produced unless there is a high quality workforce working with a high quality production process; and a high quality workforce can only be maintained when there is a high quality of working life. Each complements the other and each is necessary for the other. Within this framework, the pursuit of quality depends on using each of these aspects to enhance and reinforce the others. The management of quality in this regard is then a matter of philosophy, of commitment, of partnership, and of scientific improvement.

MANAGEMENT OF QUALITY

Quality is a matter of philosophy because it lies in societal values.

Quality needs top management leadership and involvement. Quality improvement is a top management issue. It is a strategic issue for staying in business long-term and is just as important as profits. Quality can only be accomplished by top management leading the charge.

Quality is a matter of commitment: long term commitment, commitment to the customer, commitment to the workforce, and the society.

Quality needs to be planned for and sustained in the long run. It is not a one time decision, it is a continuous process. The customer's needs and expectations about products and services are of ultimate importance for long term survival. Ignoring customers will have long term detrimental effects. Customers are getting more critical towards bad quality, are more informed and are constantly increasing expectations. Only by being able to satisfy and even anticipate these

higher expectations will companies be able to prosper in the long-term. The workforce is the most important asset of any company. Long term commitment to the workforce, appropriate training, development, and reward systems are prerequisites to creating a climate that fosters creativity, participation, involvement, satisfaction, and ultimately performance and quality.

Quality is a matter of partnership, between management and the workforce, with suppliers, manufacturers, assemblers, sellers, repairers, service providers, and customers. Team work, participation, and coordination are important management practices that will support a quality philosophy. A change of culture to "us together" and trust, rather than adversarial and confrontational labor-management relationships is of ultimate importance.

Quality is a matter of scientific improvement. There is always a better way of doing things. It is the job of everybody to think about how to do things better. Investigation, creativity, and directed experimentation are the basis for quality improvement. Quality initiatives should be pushed as far upstream in the process as possible. We should constantly seek to remove the causes of bad quality and design good quality into the systems. Improvements are based on careful scientific studies supported by data and information. Observational studies and designed experiments should be conducted using scientific principles of induction and deduction in a continuous, never-ending search for improvements. Statistical and research methods play essential roles in this process. Inspection for quality is replaced by efforts of everyone to remove causes for, and prevent, bad quality.

HISTORICAL AND THEORETICAL BACKGROUND

It was not until the early 1930s that quality control became a discipline in its own right. The American physicist and statistician Dr. Walter A. Shewhart, published the seminal book "Economical Control of the Quality of Manufactured Product" in 1931. Shewhart inspired the British statistician Pearson to start similar quality initiatives in England. Industrial and social changes precipitated the creation and implementation of new management theories concerned with productivity. Taylor's Scientific Management Theory (1911) provided the tools and techniques as well as a management system to design work systems that

would produce a high quantity of output. The principle of division of labor initially proposed by Adam Smith (1776) was a cornerstone of Scientific Management. Work specialization was to provide savings because tasks were easy to learn, and unskilled (and cheap) workers could perform these simple tasks. In addition, Taylor recommended the use of scientific methods to gather, quantify and record information on the tasks being performed in order to develop better working methods and increase management control over the production system. Such a system could guarantee a specific quantity of output. However, Taylor recognized that quantity may be increased to the detriment of quality. Thus, he recommended the use of 'over-inspection' to ensure high output quality. The advent of large manufacturing production units precipitated the development of inspection procedures. The application of statistical techniques to quality control further developed the techniques of the inspection function. Statistical process control makes use of basic statistics (frequency distributions, histograms, ranges, means, standard deviations) to summarize process information. The amount of information needed to control phases of the process led theorists to study alternative sampling strategies. Once collected and summarized, this information can be charted and graphically presented in a way that allows detection and analysis of quality problems. Statistical theories provided the tools to facilitate the management and resolution of quality problems. Thus, there were parallel developments in management and statistics theories that dealt with quality control.

On one hand, early management theories were complemented by theories aimed at improving the quality of the workforce as well as the

quality of working life. Among the numerous approaches, we can cite Theory Z (Ouchi, 1981) that originated from a study of managerial practices of Japanese companies and Social Learning Theory (Bandura, 1977) that originated from the field of social psychology and emphasized the concept of personal efficacy that may be associated with personal quality.

On the other hand, statistical methods have played a fundamental role during the last half century in putting the design, analysis, and control functions in manufacturing organization on a scientific footing. Rigorous methods using statistically-designed experiments to discover the relationships among process variables and final product quality characteristics were developed throughout the mid-20th century by statisticians including Fisher (1935), Plackett and Burman (1946), Box and Wilson (1951), and Box and Hunter (1961a,b). Box and Bisgaard (1987) summarized the scientific context of quality improvement. More recently, the use of statistical methods to aid the design of "robust" products and processes has been popularized in Japan and the U.S. by Taguchi (1986); see also Box, Bisgaard, and Fung (1988). Very simple graphical methods for summarizing and analyzing data were belatedly recognized in U.S. industry in the 1980's as enormously powerful tools for the diagnosis of quality problems. Of particular note are the "seven tools" of Ishikawa (1976). Deming (1982) played a determinant role in emphasizing the importance of statistics and constancy of purpose. Juran (1974) developed his quality trilogy and the project-by-project approach. Feigenbaum (1983) focused on total quality control and the cost of quality. Crosby (1979) popularized the concept

of "zero-defect." Taguchi (1986) introduced the notion of loss function in the quality field.

Statisticians such as Deming (1986) and Juran (1964, 1974) tried to merge statistical concepts of variation with management principles into approaches to management of quality that are very popular in certain industries. Deming's and Juran's distinction between quality defects due to system problems and those due to worker problems reflects the distinction between variation due to common (system) causes and those due to special causes.

When the National Broadcasting Company (NBC) aired the film "If Japan Can, Why Can't We" in 1980, featuring Dr. Deming, interest in quality management increased in America. Several large American corporations, including the Nashua Corporation and Ford Motor Company began to develop programs and many more have followed. Today there are numerous companies that have embarked on quality improvement projects and some companies are beginning to establish quality management systems. Some examples include Hewlett Packard Company, Harley-Davidson, Ford Motor Company, General Motors, IBM, General Electric, Kodak, Motorola, Westinghouse, 3M, Globe Metallurgical Inc., and General Foods. One of the latest developments is the proposal for using quality management principles in the defense industry. An important element in this is the report "Concurrent Engineering," developed by the Institute for Defense Analysis and the Department of Defense (to be released in 1989) and the Air Force document R&M2000 (U.S. Air Force, 1987). However, even with these widespread initial efforts at quality management, American industry as a whole has not

embraced the concepts of quality management, and this failure is a serious concern for our international competitiveness.

It would be wrong to give the impression that quality represents an entirely new theory of production management. While some of its tenets question existing approaches, most are complementary to existing management theory. Several theorists have proposed ways to achieve higher quality and output, including A. Smith, F. Taylor, H. Gantt, E. Deming, J. Juran, G. Taguchi, K. Ishikawa, and P. Drucker. If one were to examine the theorists superficially, one might suppose that they differ substantially in their proposals. Yet, underlying all of these theories is the belief in the need to fundamentally change the way in which the workplace is managed to provide better direction to the production process. Thus, while the means for achieving this fundamental change may differ, the basic philosophy that better management is required for improvement, along with specific tools to achieve improvements, is at the heart of each. They have proposed scientific, systematic methods for measuring, charting and testing the feasibility and effectiveness of various "techniques," "technologies," or organizational approaches. All believe in the importance of collecting data or information to define the "needs" and to measure the effectiveness of interventions. All underline the critical role of feedback to management, to professionals, and to workers so that continuous improvements can be made, and the same mistakes are not repeated. All espouse the critical need for top management commitment and support of the "new" concepts and the interventions. Many define a

critical role for the employee in the definitions of need, and some in the execution of the interventions.

Even if these theories have some common management principles, there is a need for further theoretical research to assemble the different pieces of the puzzle and propose an integrated theory of management of quality. An integrated theory will be useful only to the extent that it is being successfully used and implemented by companies. The successful implementation of quality initiatives and programs is a difficult problem. Successful ways to implement quality programs, rational justification methods, and empirical long-term evaluation studies have to be developed to overcome resistance and make the quality movement a real change and not just a fad.

QUALITY: SPECIFIC PROBLEMS AND DIFFICULTIES

New Approach to Quality

Only a small percentage of American companies practice quality management, much less than in other industrialized nations that compete with us. A survey reported by Putnam (1985) indicated that only 1 out of 300 companies involved management and engineering staff in quality training. In Japan, the majority of managers and engineers are trained in quality, and quality management is embedded from the beginning of product development. In the U.S., the tendency is to have a quality control department, separate from other functions, which has to deal with quality problems as they occur. More companies need to become aware of the new quality paradigm, and its implications for business practices.

Leadership

The heart of the quality issue is leadership; in industry, labor and government. Such leadership must provide the "role models" and foster the "climate" for achieving high quality. The Japanese have made huge strides in quality by making it a national commitment and a way of life. A fundamental change in philosophy about quality was accomplished through changing the ideals of industry and government leadership. In the United States, effective businesses achieve quality by instilling a "corporate culture" that emphasizes quality as a corporate policy driven from the top (corporate leaders). Not all leaders are aware of the need for quality. Just as critical, many do not know what to do to achieve quality. Some are ignorant of the basic philosophy, principles and techniques that produce quality, and they must be educated and convinced.

Business Practices

Our business practice of emphasizing short term profit rather than long term gain adversely limits quality efforts. It has taken the Japanese decades to establish the type of corporate "culture" encountered in their successful companies. Short-term profit maximization undercuts processes prominent in these Japanese cultures, especially employee involvement, loyalty and trust. Several basic business practices of American companies have adversely affected quality. These include authoritarian management which limits employees' participation; after-the-fact inspections to catch defects, failure to trust employees as reflected in electronic performance monitoring, and

emphasis on quick profits. It is difficult to build workforce loyalty and trust in organizations where the managers are continually changing. Likewise, employee involvement in workplace improvement is difficult to obtain when the production process and the employees are "squeezed" and employees receive little or no gain from improvements. Quality is built on cooperation and mutual benefit for management and labor, business and suppliers, industry and government, industry and educational institutions and government and educational institutions. These relationships take time to develop, prosper and mature. They cannot be achieved over the short-term. Currently, each is going about its business independently, without an understanding of how their independent actions can adversely affect other sectors. This lack of integration is costly, wasteful and counterproductive.

Rapid Development of New Products

In an attempt to keep ahead of the competition, companies around the globe strive to get new products into the marketplace as soon as possible. This has brought about a new approach for speeding-up the design process called "rapid prototyping." In this approach, new designs are developed and tested in a fraction of the time new products normally take, typically a few months. Time constraints have sometimes meant that serious design problems were not recognized. Speeding-up of new product introduction also requires the production process to come on-line as fast as possible. The production system no longer has time to work out the "bugs" that always accompany producing a new product. The reduction in design time, coupled with the lead time to get

production processes ironed-out, are major causes of new product defects and reduced product quality. While the idea is to beat the competition to the marketplace and to establish a "beachhead," if the product is of poor quality, the advantage of early introduction can be quickly lost. In Japan, the Quality Function Deployment (QFD) system has been developed to cut problems in the design stages and shorten the development time, while assuring users' satisfaction (King, 1987). QFD is just beginning to be used in the United States.

External Environment, Political and Legal Factors

Contextual considerations include economic factors, such as employment levels; social factors, such as education; technological factors and political/legal factors. One example of how laws and policies can affect quality enhancement programs is the potential legal role of the National Labor Relations (NLR) Act and its National Labor Relations Board regarding productivity and quality-related employee participation groups. Bohlander et al. (1983) showed how employers could be in violation of the NLR Act through involvement in creating and maintaining employee participation programs, such as quality circles and quality-of-working-life programs. There is legal foundation for considering such programs labor organizations, especially if they deal with wages, hours, or working conditions. Furthermore, when employers create and maintain participation groups, violations of the NLR Act are likely if they deal with the above issues. On the other hand, if employers specify and reinforce that participation groups deal only with

productivity and quality, legal difficulties may be avoidable. To date no legal precedent has been established.

The Changing Focus of the International Marketplace

The primary impetus for achieving quality of products, services and technologies is to capture markets at home and abroad which will improve the economic health of the nation and ensure full employment. For decades the United States had a competitive advantage in the knowledge, technology and skills to make the best and cheapest products. This has changed in the last two decades and our industries are experiencing a loss of both international and domestic markets. Part of our loss can be tied to a lack of national policies and actions that promote fundamental improvements in our competitiveness while other nations have established such policies and taken such actions. For example, the Japanese government through tax laws, price supports, regulatory practices and tariffs encourages expansion into foreign markets while protecting domestic markets. Similar actions occur where nations are allied for economic opportunity such as the European Common Market.

In the United States, internal competition among businesses is a cornerstone of our free market system. Some nations have turned this concept around by reducing internal competition and promoting competition in the international marketplace. National policies have been shaped to promote the competitiveness of products and services overseas. A prime example is labor laws which guarantee a plentiful supply of inexpensive employees. For example, electronics assembly,

which existed primarily in the United States and Japan a decade ago, is now done primarily in Korea, Taiwan, Malaysia and Singapore where there is much cheaper labor. We will never be able to compete with these nations if labor cost is the determining factor, nor will we want to if it means lowering our standard of living just to be competitive. However, if the United States is to become more competitive, there must be fundamental changes in our national policies that will give us advantages that can overcome those of our competitors.

People, Management and Workforce

The importance of the role of people in quality has been recognized by the theorists and by most companies that have quality management programs. However, the unwillingness of some U.S. companies to involve all levels of employees in workplace activities is a major problem in instituting quality management. Likewise, the importance of job design, employee training and development, reward systems and labor/management relations have not been completely accepted by industry as critical aspects of quality at work. When it comes to labor/management relationships, unions are often suspicious of management initiatives for improving quality because they believe that these initiatives are attempts to reduce the influence of the union. Some quality efforts, e.g., quality circles, have emphasized obtaining good ideas from employees to improve profits, without providing rewards to the employees. On the other hand, it has been shown that union involvement in quality enhancement programs may have positive outcomes for the union itself, such as the potential for increased union

membership (Thacker and Fields, 1987), and increased willingness for the rank-and-file to participate in union activities (Gardell, 1982). Cooperation between labor and management seems to be a success factor in quality enhancement programs (see for example Miljus, 1986).

Workforce and Education

Our workforce is not adequately educated, nor are they educated in a manner that promotes the processes required for improved quality. Such considerations as teamwork, improved written and oral expression, use of mathematics and science to solve "real-life" problems, and specific technical skills tied to current and new technology need more emphasis. Our school systems have myriad curricula, educational approaches and teaching techniques which vary from school district to school district and even within a school district. Almost no emphasis is put on technical training or skills training at the secondary school level. For students not planning on attending college, the availability of high school coursework that is applicable to their life and work after graduation is very limited.

Recently, media reports have highlighted the poor performance of American students at the primary and secondary school levels in mathematics when compared to students from other nations. In these international comparisons, American students have come in last place for all industrialized nations. Poor experiences have been noted for science knowledge comparisons as well. This has prompted a vast number of suggestions from experts on the need to change the American educational system. Most experts call for going "back to the basics"

with increased emphasis on reading, writing, mathematics and sciences. The argument is made that the foundational skills established in primary and secondary education determine the extent of future learning at more advanced levels. The difficulty is that there are many experts and they do not agree on the best course of action. This has led to inaction.

On the whole our nation's technical schools are woefully inadequate when compared to those of Japan and Western Europe. We have far fewer schools and less technical resources in those schools. Our curricula need updating and improvement, as do the physical plants (particularly the equipment and technology) which are inadequate and outdated.

Where will all the professionals needed for this increased emphasis on quality come from? There are only a handful of degree programs that deal with quality management. Studies have indicated that this country faces a serious shortage of engineers and scientists in the coming century, particularly at the post-bachelors degree level (Engineering Education, 1987). A serious problem is that most American undergraduates do not go on for advanced degrees. Foreign nationals represent over fifty percent of the enrollment in our engineering, mathematics and science graduate degree programs. We are educating the world so that they can compete better against us.

A final educational issue is the competence of the nation's teachers to provide quality instruction. Several studies over the last few decades have shown that teaching is not attracting the brightest and the best of our young college graduates. The reasons for this include low pay, hostile students and parents and little job glamor. Industry

is paying better salaries and providing better benefits. Because of a concern over the quality of instruction, some states have gone to teacher competency testing which is similar to professional licensing. Such testing is like after-the-fact inspection, where it is too late to build in quality after the product has been completed. As with defective products, poor teachers will have to be "taken apart and rebuilt." It is very costly to improve teachers after they have finished their education. The time for developing excellence is when they are being educated.

Workplace

The workplace has undergone substantial changes in the last two decades, some of which have adversely affected the quality of working life (Smith, 1986). More pressures for production, which may be caused by international competition; increased job stress; hostile takeovers with the potential for the splitting-up of corporate assets, have all created a work environment that defeats employee commitment to quality. Management theorists (see Neugarten, 1985) have recognized the need for a pleasant and rewarding job environment to motivate employees to quality performance. Yet there has never been a more stressful time in our nation's history as regards the workplace (Centers for Disease Control, 1986). There are still thousands of workplaces that do not invest in the comfort and satisfaction of their employees.

Technology

Technology has had a major influence on enhancing the productivity of American industry, especially in manufacturing, process industries, insurance, banking and finance. Many American companies are looking to information technology, electronic data processing, telecommunications, office automation, computer-integrated manufacturing, to win back their dominant position in the global marketplace. After huge investments, many companies have discovered that these powerful competitive tools have not met their expectations. Monger (1988) identifies three major interrelated sources of improper technology management that explains the loss of quality and productivity: low rate of technology absorption, high level of implementation failure, and poor handling of social consequences. The Task Force on Management of Technology commissioned by the National Research Council (1987) examined the state of research, education, and practice in management of technology. They found avoidance or poor understanding of the interrelationships between people and technological systems is a major failure factor, as well as lack of management support and involvement. Successful integration of new technology has the potential to sustain competitive advantage. However, new technology is not without its human costs (see Smith, 1985). These costs threaten to undermine the confidence of the workforce in the stability of their employment and the commitment of their employers to their welfare (OTA, 1984, 1985a, 1985b, 1985c, 1987; NRC, 1987; Henderson & Mowery, 1988; Cyert & Mowery, 1988; USDOL, 1988). Employers see technology as a way to reduce the cost of production by replacing expensive labor. Employees see the stability in their employment eroded

by technology because of increased or new skill requirements and job loss. This kind of working environment breeds distrust and reduces employee commitment to participation and quality management. Many of our competitor countries provide employment guarantees either through the employer or government programs. In these countries, technology is used to increase the capabilities of the employee rather than to replace the employee. Thus, it can serve as a motivator and enhance commitment to high quality.

POLICY ISSUES

National policies must deal with actions that will improve the quality of our workforce and of working life, enhance the quality of our products, services and technologies, generate new technologies, provide technical assistance to industry and commerce, and establish the leadership to move into the next century of international competition. The following policy issues and proposals address ways to achieve improved quality at the workplace. We divide them into five categories: policies addressing the philosophy of quality, policies pertaining to the workforce and education, policies for improving the management of the workplace, policies regarding the conceptual base underlying management of quality, and, finally, policies for putting theory into practice. A general initial recommendation is to establish a taskforce to examine these policy recommendations, prioritize them, and make them operational in terms of concrete actions to be taken.

1. PHILOSOPHY OF QUALITY

Philosophy Policy 1. Institute New Federal Initiatives to Promote Quality

Establish a Presidential Commission with representation from the U.S. Department of Commerce, U.S. Department of Labor, Department of Defense, Internal Revenue Service, Department of Health and Human Services, business leaders, labor leaders and academics to explore ways to promote new business and government practices aimed at quality that will contribute to the long term stability of the nation's economy and jobs while providing a profit incentive to investors and owners. In addition to this commission, establish activities in several federal agencies for promoting workplace quality.

Encourage the newly-established White House Task Force on Competitiveness, which is headed by the Vice-President (Business Week, February 27, 1989), to promote quality as a necessary component of our international competitiveness. A recognition of the importance of quality by the White House will provide the national focus necessary to generate greater management and labor interest.

As an alternative or an adjunct to the Presidential Commission on Quality and Competitiveness, establish study groups for promoting quality at the National Academy of Sciences/Engineering and/or the Office of Technology Assessment of the U.S. Congress. These groups would provide a more scientific and theoretical focus than the Presidential Commission which would focus more on pragmatic issues of implementation.

In addition to these taskforce activities, quality programs should be established in several federal agencies which have important functions that influence the nation's quality. For instance, the Department of Labor has programs which regulate relationships between labor and management. These programs govern aspects of wages and benefits, responsibilities of labor and management, employment and unemployment, safety and health, and cooperative relationships. Underlying several of these programs are federal laws such as the National Labor Relations Act. Quality efforts require cooperation between labor and management, and demand participation of employees in the decision-making process. This requirements suggests new relationships will develop between management and labor. Some of these new relationships may be in violation of the National Labor Relations Act. It may be necessary to change this labor law to redefine the relationships between and responsibilities of each of the parties. We propose that the Department of Labor establish a taskforce to examine current labor laws in light of the needs of quality programs, to establish new relationships between labor and management. We further propose that the Department of Labor undertake research to define the need for new labor laws that may be necessary to protect employees when new quality initiatives are started. We also feel there is a need for research into the organizational strategies and structures that will promote effective quality management.

The Internal Revenue Service should undertake research to determine potential changes in the tax laws that will promote quality and international competitiveness. For instance, the costs of

instituting quality programs could be covered by tax credits to offset short term loss of profits due to investments in quality. This could remove a major barrier to investments in quality caused by current business emphasis on short-term profit maximization. Other concepts that could act as an incentive to employers for promoting quality include accelerated write-off or depreciation for quality-related investments, and expanded tax write-off for rewards or bonuses given to employees for their quality efforts. These types of special tax treatment for specific investments have been shown to be effective in stimulating investment, if the investments can also be tied to improvements in workplace efficiency. Investment in quality management clearly meets this criteria.

The Department of Health and Human Services should establish quality management requirements for providers of medicare and medicaid treatment. Providers failing to meet these requirements would be subject to reductions in payments and fees for services. This program would serve as a model for private health care insurers for promoting quality health care. Such initiatives could be expected to improve health care, reduce health care costs and thereby reduce the cost of American products and services.

The Institute of Medicine (1986) published the results and recommendations of a study aimed at improving nursing home regulation. The study's purpose was to recommend changes in regulatory policies and procedures to enhance the ability of the regulatory system to assure that nursing home residents receive high quality care. Agencies such as the Health Care Financing Administration, the Joint Commission on

Accreditation of Hospitals, the Institute of Medicine, along with professional associations such as the American Medical Association, should pursue such initiatives with a different emphasis. Most of the recommendations generated from this study (Institute of Medicine, 1986) addressed legislative issues, certification regulations, and assessment procedures. In addition, studies are needed to identify policies that will stimulate quality initiatives and assist health care providers in promoting quality, rather than policies aiming at inspection and enforcement.

The Department of Defense and the National Aeronautics and Space Administration are this country's largest contractors for manufactured products and special services. These departments have unusual needs for high quality products and services since the consequences of poor quality could be disastrous. Each spends billions of dollars every year for ensuring quality, yet there is no evidence that these expenditures provide improved quality, performance or safety. These agencies still need major improvements in quality of the products and services they purchase. These improvements should start with the development of enhanced quality management programs which should be administratively managed at the highest levels of the agencies. These programs can be models for private industry. The Department of Defense has already taken steps to ensure that vendors use quality and reliability principles through such programs as the Air Force R & M 2000 process and the August 1988 Total Quality Management Master Plan. Similar requirements are under discussion in the Institute of Defense document

"Concurrent Engineering." More of these kinds of efforts need to be initiated.

The Department of Commerce should examine ways to promote quality management for enhancing the competitiveness of American industries. The recently established Malcolm Baldridge National Quality Award is one good first step. However, it is a small step that needs to be enlarged. Sometimes internal competition can be divisive and drive the costs of production up, to the disadvantage of international competitiveness. The Commerce Department should develop a recognition program for cooperative efforts among suppliers, manufacturers and marketers. The concept of an industry "family" where banks and financial institutions work closely with manufacturers, suppliers and marketers, who also work closely together has been extremely effective in Japan. Similar relationships could be effective for American companies engaged in international competition. The Commerce Department should sponsor research into mechanisms for promoting such cooperative efforts. Some of this research should be undertaken jointly with the Justice Department to examine how our laws on anti-trust would impact such arrangements. It may be pertinent to determine how our anti-trust laws affect our international competitiveness, and propose changes where necessary.

Philosophy Policy 2. Increase Quality Awareness

Widely disseminate ideas and educational materials about quality. This could be done through the Presidential Commission on Quality and Competitiveness and/or by a lead federal agency such as the Department

of Labor or Commerce. These agencies should work with employer associations such as the U.S. Chamber of Commerce as well as labor organizations such as the AFL-CIO to promote member interest and involvement in quality. Cooperative government and private efforts need to be undertaken to demonstrate the importance of these issues and ideas.

The ideal approach would be for a Presidential Commission headed by a senior administration official to increase public interest in and awareness of the issue of quality and competitiveness. This would provide a national perspective and recognition of the importance of this issue. These efforts should be primarily promotional and could be supplemented by a special program that combines the efforts of the Departments of Commerce and Labor to develop specific materials for employers and labor unions to implement quality management. This program can collect, collate and disseminate materials from successful quality management efforts and quality research and academic programs on quality.

Several professional groups such as the American Statistical Association, the Institute of Industrial Engineers, the American Society for Quality Control, and the American Management Association hold annual conferences concerning productivity and quality improvement. These conferences are typically attended by technical personnel or mid-level managers, but almost never by top managers. While these conferences provide excellent information for their participants, the significant message of the need for more emphasis on quality and competitiveness is seldom communicated to top corporate executives. These conferences

should be encouraged to continue and provide their valuable information to technical staff and managers. But, there also needs to be a mechanism that will stimulate top management interest and action. One concept is to hold an annual senior management and labor one-day seminar that provides state of the art information to CEOs and labor leaders. The Vice-President, as head of the White House Task Force on Competitiveness, would be an ideal keynote speaker. The format would be casual and relaxing to stimulate a pleasant environment free from the hassles of daily work and confrontation. This type of seminar could serve as a short "break" that would provide a chance to "charge batteries" while learning about important tools and concepts for improving quality at the workplace. Speakers would be world class experts who can provide a clear message in non-technical terms to stimulate intellectual interest and receptivity to further information. Talks probably should not exceed one hour and should be followed by a discussion among the participants. We suggest that no more than three speakers or messages be presented at a seminar to keep the information load manageable. It would be advantageous to have speakers with similar or complementary messages at each seminar to reinforce specific concepts and actions. A lead federal agency could sponsor the first seminar under the direction of the White House, with Presidential invitations to a selected group of initial participants. In later years, the professional associations and business and labor associations could take on responsibility for continuing the seminars, with technical federal agency assistance as needed.

Philosophy Policy 3. Motivate and Recognize

Provide recognition for individuals and companies that demonstrate leadership in the pursuit of quality by expanding the Department of Commerce's quality awards program to a greater number of companies, and by enhancing the efforts of professional societies such as the American Statistical Association and the Institute of Industrial Engineers. Current programs have only a limited number of awards, which substantially reduces the motivational potential particularly for small companies. Voluntary industry efforts to raise funding could be coupled with federal grants to increase the size of awards. Further efforts should be taken to reward individual employees and managers who make substantial contributions to quality improvement and competitiveness. For instance, the Vice-President of the United States could establish awards and have a special ceremony each year for both the companies and individuals who make contributions to quality.

In Japan, one of the most prestigious industrial awards is the "Deming" quality award given annually to companies that best exemplify principles of quality management. This award is much sought after and serves as a spur to corporate quality efforts. The Deming prize is not a contest but is awarded to those companies that meet a predefined standard. The effectiveness of this award to motivate a high percentage of Japanese companies is based on the "culture" that has developed in Japanese corporations around quality management. This "cultural emphasis" indicates that awareness of the need for and benefits of quality management are widespread in Japan. In America, the Baldridge award involves meeting a standard as well as competition since a maximum

of two companies per category are awarded each year (Bush and Dooley, 1989). There is not the same high level of awareness of quality issues as in Japan, and so a single award or small number of awards does not have the same strong motivational power. What we need is to use awards to build awareness and recognition of the need for quality improvement. This suggests a strategy that provides awards for different purposes than just being "the best." Awards should be given not only for excellence of quality programs, but also for improvements in programs, for initiation of programs, and for sharing and assistance among programs. The idea is to stimulate corporate interest. An awards program should have local aspects that can lead to regional and then national recognition. This should be a recognition program and not a competition program. A basic concept should be to foster exchanges of ideas and techniques among companies to enhance our international competitiveness.

Philosophy Policy 4. Make Expertise Available

The federal government should develop a system for collecting information about quality management and making it available to companies, unions and educational institutions upon request. This clearing house activity should be supplemented by a program that digests quality management information and research, and provides guidance about how to implement or improve quality management methods. A basic problem faced by American industry is to determine how and when to apply the myriad of quality management concepts which are sometimes not in agreement. Techniques that have been successful in Japan may not be

successful in America. A good example is "quality circles," which have not had as much success in America. Industry and commerce need help in sifting through the information and determining the best alternatives for their specific applications. Experts often have a vested interest in a specific approach, which limits their objectivity. Thus, it is important to have a central resource that can provide information and direction in a neutral way.

There is also a need for more professionals who can work on quality management. The Departments of Labor, Commerce and Education should develop programs that provide grants to colleges and universities as incentives for business schools and colleges of engineering to develop the technical experts and leaders that will be needed for increased quality management efforts. The demand for experts created by increased emphasis on quality could be huge, and currently there is a limited supply of such individuals. There are few quality programs at institutions of higher education. There is a need to substantially increase the pool of expertise, and this can best be accomplished in the short run by providing incentives for developing such programs. In the long run, industry demand will provide the impetus for these programs to continue.

2. WORKFORCE AND EDUCATION

A major problem with implementing quality management is the need to have a workforce that has the intelligence, skills and motivation to effectively participate. In this regard, America has a competitive advantage over the developing countries. But, the same may not be true

when we are compared with other industrialized nations; and the comparative disadvantage may be increasing. Recent tests comparing grade school and high school students in industrialized countries on mathematics and science showed American students scored the poorest. If technology is to remain one of our main competitive advantages, then we need to have the requisite brainpower to continue to develop and apply new technology. This means an educated workforce.

Educational Policy 1.

Establish a program in the U.S. Department of Education for the improvement of the quality of national education. This program would provide guidance to local school districts, colleges and states regarding aspects of curricula, provide resources for curricula development, provide funding for teacher improvement in areas of national need, develop a program of educational grants to encourage bright students to pursue education and careers in teaching, develop guidance regarding national vocational education needs, provide grants for improving the equipment and technology used in instruction, and provide leadership in addressing national educational needs for improving the quality of our workforce. Some small efforts in this regard are already underway at the National Science Foundation.

One serious problem with this concept is the current widespread differences of opinion among experts as to the most fruitful ways to improve our educational system. While mathematics and science scores of our youngsters in primary and secondary schools generally fall behind those of other industrialized nations, there has been improvement in

test scores over the last decade. If test scores are really an indication of the knowledge level of our children, then this improvement is promising and may mean that the current directions in education should be maintained. On the other hand, it is quite clear that our high school graduates who go directly into the workforce are lacking many of the skills necessary to be productive. Boeing Corporation has had to offer remedial high school level education to about half of the several thousand new high school graduates it hires each year, with about one quarter of these new hires needing help with basic literacy. This clearly shows a need for high schools to emphasize technical skill development for students not wishing to pursue college, and also requiring basic competencies in reading, writing and speaking for graduation.

At the post-secondary level there is a need to increase vocational training. Such training should be built on cooperative efforts with local industries to develop skills that are relevant to job needs and to provide internship opportunities. Such cooperative efforts could include continuing training for employees who need skill improvement or extended skill levels due to changes at the workplace. Cooperative efforts are currently underway in several states as part of recruitment packages to get industries to settle in or to expand or maintain operations in a state. These have been very effective in providing industry with the type of employees it needs and for building stability in employment for the workforce. A national effort should be considered to expand this concept and to shift the focus away from interstate competition for industry to national competition against other

countries. This training support could provide special assistance in job creation to high unemployment areas.

There is also a great need to develop the engineers and scientists who will be inventing the new products and processes that will enhance our international competitiveness. We have already proposed a federal program of support for specialties concerned with quality management and quality education. But there is also a need to increase the number of engineers, scientists and managers. The best long-term approach is for marketplace demand to encourage colleges and universities to produce more of the needed professionals. This will be successful in the long term. However, industry is not always at the cutting edge of what is best, and sometimes industry is hesitant to move in new directions. To promote new initiatives in critical professions, the Federal Government should provide special funding to the National Science Foundation for educational and research programs.

At the heart of good education is excellence in teaching. Yet many of our brightest and most motivated young college graduates are not going into teaching careers because of poor pay and a growing lack of status and respect for teaching as a profession. Federal programs must be established to counteract this trend, and to attract our best young minds for careers as teachers in mathematics and sciences. Such programs could increase the extent and amount of forgivable loans for persons pursuing teaching careers in these areas. In addition, grants may be necessary on a short-term basis to encourage students into these fields.

Educational Policy 2.

Establish a program in the U.S. Department of Labor to provide guidance to the U.S. Department of Education, local school districts, colleges, states and individual employers about the needs for specific skills in the workforce, provide technical assistance and grants for specific skills training of the workforce that will enhance the nation's international competitiveness, and conduct research into efficiency, productivity, and quality issues. Some experimental programs to teach quality-related principles have been implemented in schools and provide a starting point (Sarazen, 1989).

Our most important and effective resource in meeting and beating international competition is our workforce, both labor and management. Their technical skills need to be improved and, once improved, kept current. There is also the need to develop other skills that lead to more effective quality management such as teamwork, problem solving, and leadership. All of these training activities take time away from production. Even though they develop skills that will enhance quality and competitiveness in the long run, they are expensive to implement in the short run. To encourage employers to undertake workforce improvement and training, special tax credits and/or write-offs should be given for providing training that will promote quality and competitiveness. The specific areas should be defined by the Department of Labor and approved by the Internal Revenue Service.

3. MANAGEMENT OF THE WORKPLACE

A significant issue in the improvement of quality is providing better management of the product development and production processes. All quality improvement theories recognize that quality begins with top management which sets the tone for other levels of management. Managers must not only be cognizant of the importance of quality, they must also be competent to promote quality. This suggests the need for upgrading the knowledge and skills of managers.

Management Improvement Policy 1.

The Department of Labor should expand current programs aimed at improving labor-management cooperative relationships by including issues of quality management. Quality management theories recognize the importance of worker input to the quality improvement process, and this concept should be promoted.

There is a need for fundamental changes in how our production resources are managed. The time when labor and management could afford to be divisive is gone. Many foreign firms do not suffer from adversarial labor-management relations, a distinct advantage for them, particularly when it comes to cooperative programs such as quality management. Employers must take the initiative in this arena by demonstrating that they are willing to share information with the workforce and to have labor input to decisions that influence working conditions, technology and jobs. Many employers already subscribe to some form of participative or cooperative management, yet they are a minority and more need to adopt this philosophy of management. America

will only be able to be competitive by working smarter than our international competition, not by simply working harder. Working smarter means working together for the common good of the organization and its members. It means getting full contributions from everyone in the organization by utilizing the full range of skills and intellect. It means giving everyone a chance to participate.

Management Improvement Policy 2.

Government agencies should play a leadership role in improving in-house quality. The Internal Revenue Service started a quality program, which is now beginning to serve as a model for Federal agencies. Efforts such as the President's Council on Management Improvement and OMB Circular A-132, Federal Productivity and Quality Improvement in Service Delivery should be expanded. Government agencies should implement quality enhancement programs in their own facilities starting with pilot projects and then disseminating quality efforts throughout the entire organization. The leadership role taken by governmental agencies should serve as an incentive for other organizations to implement programs. In addition, these experiments should provide guidance and information on success factors, and on difficulties encountered in designing and implementing quality programs.

4. CONCEPTUAL BASE-BUILDING POLICIES

Conceptual Policy 1.

The Department of Labor should encourage theoretical research in the field of quality management. In particular, priority should be

given to interdisciplinary research that tries to integrate different perspectives into a whole. In addition, applied research should be stimulated so that information and knowledge can be gathered on the success and failure factors in promoting quality. Theoretical and applied research that studies quality programs in service industries should be a priority over similar research in manufacturing. The Department of Labor should expand its efforts to collect information systematically on quality enhancement programs, for dissemination purposes.

To attain effective developments in the field of management of quality, strong collaborative efforts of government, industry, labor, and academia will be required. The key will be to build on knowledge of quality management with new research efforts, and to give the many issues involved in effective management of quality more emphasis in the training of both engineers and managers. Government will need to support research efforts in management of quality; industry will need to open companies to the researchers and be receptive to their findings; and academia will need to engage more actively in interdisciplinary research and education.

Conceptual Policy 2.

The National Science Foundation should support research in management of quality that would identify important issues and needs, address the problems mentioned above, begin to test existing solutions and approaches, and define new solutions. Support mechanisms should include long-term grants to individual academic researchers, funding

small-group research (including joint university-industry efforts), funding interdisciplinary centers, financial support for masters and doctoral students, supporting post-doctoral fellowships, stimulating the interest of other agencies by holding interagency conferences, and disseminating the results of the funded programs. Additional selection criteria could be added for the rating of research proposals to address issues of quality improvement, quality management, and competitiveness.

Industry should commit itself to the process by recognizing the potential for management of quality to be improved through research and education, developing partnerships with universities, providing test sites for research experiments, employing graduates with good training in management of quality, and providing them with an environment suitable for them to make a contribution.

5. POLICIES FOR PUTTING THE THEORY INTO PRACTICE

Many experts and practitioners emphasize the difficulty in putting quality management theories into practice.

Practice Policy 1.

The U.S. Department of Labor should continue to keep track of companies and unions with cooperative experiments (see the directory entitled "Resource Guide to Labor-Management Cooperation"). The directory should include experiments emphasizing quality. A new classification, and an expansion of the directory, may be required, to include federal, state, city and local government programs. Some of these are unique in promoting community-wide efforts in quality

improvement among private and public employers. This directory will be a valuable source of information for quality practitioners at all levels, and should include both successful and unsuccessful programs.

Practice Policy 2.

Networks of industry, union, academic, and government representatives should be and established at the national, regional, and/or state levels. Examples are the Madison Area Quality Improvement Network (MAQIN) and the Northeast Wisconsin Quality Improvement Network (NEWQIN). The goal of such efforts is to give plant managers, professionals, employees, and union representatives information on quality and productivity improvement experiences, and sources of support for designing and maintaining quality enhancement programs. Newsletters, seminars, library, and computerized data bases could be means of disseminating useful information on quality. The Arkansas Quality/Productivity Task Force is a network coordinated by the Arkansas Industrial Development Commission. Its goal is to improve the state's economic status by ensuring that companies stay competitive. The effectiveness of such efforts in gathering and disseminating useful information to quality practitioners should be assessed before similar state programs are encouraged.

States can also encourage local labor-management cooperation programs. Additional funding from the Federal government may be needed to pursue such efforts. Increased emphasis should be put by the supervising agency on trying to solve quality problems.

Companies could encourage the formation of local quality practitioners' "clubs" to share experiences and provide useful guidance to "beginners."

Practice Policy 3.

In certain countries, companies can have their quality enhancement programs audited and registered by a third-party assessment/registration agency. The ultimate goal is to encourage the dissemination of quality programs. There are various kinds of registration. The Coordinating Agency for Supplies Evaluation (CASE) was originally formed to deal with aerospace contractors. It keeps a public list of assessments carried out by its participating members, which can be purchased. The advantage of such registration is its simplicity. The disadvantage is that users of the list cannot be sure of the validity and reliability of the assessments. The Canadian Quality Management Institute, a branch of the Canadian Standards Association, accredits auditors who examine a company's quality program's conformance to specific standards. It is different from CASE because it not only registers quality programs but also assesses them. The weakness of such an agency is the risk of biased assessments because the agency not only provides assessment/registration services, but also consults in order to finance itself. The Swiss SQS organization for quality program assessment and registration is a conglomerate of recognized associations, government departments, and noncommercial institutions. They try to ensure that assessment and registration are unbiased and reliable.

Assessment/registration agencies base their evaluation on a set of criteria that quality programs must meet. Standards such as the ANSI/ASQC Q90-1987 through ANSI/ASQC Q94-1987 already define what is meant by the terms quality management, quality control, quality assurance, and quality system. The ISO 9000 series provides separate but complementary guidance for the quality management and quality system needs of a producer and supplier-customer contractual quality assurance situation. Since assessment/registration agencies use standards, the effectiveness of such standards should be continuously evaluated with changing economic, social, technological and legal conditions. However, standards are generally very hard to change and take a long time to develop. Thus, the Department of Labor should carefully examine existing assessment/registration agencies and current standards for auditing quality programs before encouraging the creation of such agencies.

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